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Giant Cell Tumor of the Proximal Fibula: Surgical Management

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Five patients with giant cell tumor of the proximal fibula were treated with intralesional excision of the lesion, preservation of the peroneal nerve, and reconstruction of the lateral collateral ligament. At minimum 24-month follow-up there have been no local recurrences. Four patients exhibit normal function of the peroneal nerve and one has grade 4 strength of the muscles innervated by this nerve. No patient demonstrated varus instability. Marginal excision with nerve preservation and reconstruction of the ligament is a worthwhile procedure for treatment of this relatively uncommon lesion. © 1996 Wiley-Liss, Inc.

KEY WORDS: **benign bone tumor, aggressive bone tumor, peroneal nerve, lateral collateral ligament**

INTRODUCTION

The proximal fibula is a relatively uncommon site of origin for giant cell tumor (GCT), comprising less than 10% of cases in most reported series [1–5]. In current practice, GCT at most anatomical sites is managed with curettage and filling of the defect with methylmethacrylate or bone graft [3–8]. However, when this tumor presents at anatomical locations which are "dispensable" from the point of view of weight-bearing and skeletal stability, the disease is often best managed by en bloc resection to decrease the risk of local recurrence [8,9]. The proximal fibula is an example of an anatomical site which is considered to be "dispensable." Despite the designation of this site as dispensable, management of the proximal fibula GCT is rarely straightforward.

The proximity of the common peroneal nerve may be a particular problem at this site since GCT of the proximal fibula often presents with a substantial soft tissues mass which may elevate and stretch the nerve. Since the nerve is already tethered by fascial bands found at the proximal fibula [10], displacement of the nerve by tumor may result in spontaneous or iatrogenic neurological complications. In addition to avoiding injury to the nerve, appropriate management should also permit reconstruction of the biceps femoris tendon and the fibular collateral ligaments. Both of these structures are important lateral stabilizers of the knee which insert on the proximal fibula.

In this paper we present the results of five patients treated for GCTs of the proximal fibula using a consistent technique that emphasized complete excision of the tumor, preservation of the nerve, and reconstruction of the lateral stabilizers.

MATERIALS AND METHODS

Patients

Between 1987 and 1992, five patients (two female and three male) with GCT of the proximal fibula were treated in our unit. The median age was 29 years (26–58 years) and all patients were treated for primary (as opposed to recurrent) lesions. Complete follow-up to a minimum of 2 years (average 3.8 years) was available for all patients who were monitored for evidence of local recurrence and functional outcome (using the Musculo-Skeletal Tumor Society [MSTS] functional scoring system [11]) every 3 months over the first 2 years, every 6 months for the next 2 years, and annually thereafter.

Technique

At the time of referral all patients underwent standard local and systemic staging evaluation that included a

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Fig. 1. Plain radiography of the proximal fibula showing expansion of the cortex by a GCT.

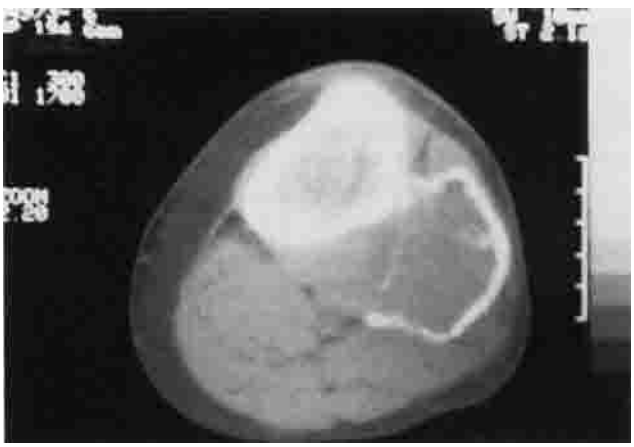

Fig. 2. CT demonstrating the typical posteromedial soft tissue mass associated with GCT of the fibula.

history and physical examination, plain radiographs and axial imaging magnetic resonance imaging ([MRI] and/or computed tomographic [CT]) of the local site (Figs. 1, 2), as well as total body bone scan and chest CT. Clinical examination of peroneal nerve function was carefully recorded as well as the presence of pulses at both the dorsalis pedis and posterior tibialis sites in the foot. Electromyography and nerve conduction studies were not performed.

In patients referred prior to biopsy, histological diagnosis was made using a core needle biopsy sample obtained in the office under local anesthetic. The needle was inserted through an area of eroded cortex in the proximal head of the fibula (as opposed to the fibular neck), generally using the CT image as an indicator of the optimal point of access. It was not necessary to perform the biopsy under direct CT guidance as the bone was easily palpated in all of our cases. CT guidance might, however, be necessary for an extremely large tumor that distorted surface anatomy landmarks.

After confirmation of the histology the patient was treated by excision of the lesion. The intent of surgery was to provide as complete a gross excision of the lesion as possible while still preserving the peroneal nerve. It was recognized that in some patients this approach might require intralesional surgery (i.e., dissection of the nerve from within the substance of the tumor) and these patients were informed prior to surgery that salvage of peroneal nerve function would increase the risk of recurrence. Following this discussion no patient requested excision of the nerve to obtain clear margins of resection.

In each of the five cases the soft tissue mass extended posteriorly into the popliteal fossa (Fig. 2). In order to increase exposure of the popliteal fossa, the biceps tendon was first taken down from the fibular head and tagged for later repair. The peroneal nerve was identified proximally and the popliteal vessels identified behind the knee. In order to retract the vessels it was often necessary to divide multiple small vessels leading to the tumor as well as the lateral geniculate vessels. Vascular dissection continued distally to the point where the anterior tibial vessel branched anteriorly. If possible the anterior tibial vessel was isolated and retracted at this point. If the posteromedial extent of the lesion was too great to safely isolate the anterior tibial vessel, this step was delayed until after fibular osteotomy.

Attention was now turned to the peroneal nerve. Dissection was generally straightforward, unless complicated by inappropriate placement of the biopsy. Exposure was carried as far distally as the fibular neck where expansion of the bone by the tumor often made division of the fibrous tunnel overlying the nerve difficult. After division of the fibrous tunnel overlying the nerve had been accomplished, anterior dissection continued along the proximal portion of the nerve until it was possible to release the fascia that separates the lateral and anterior tibial compartments. It was important to avoid dissection on the distal surface of the nerve through this region since this might result in inadvertent division of the superficial portion of the nerve as it bifurcated from the deep peroneal nerve to run down the leg in the lateral compartment. The superficial portion of the nerve was generally easily dissected free of tumor. In order to free the deep branch, it was often necessary to divide the first one or two branches which ran proximally from the fibular neck to disappear into the tumor. These branches were not dissected free

of tumor since the portion of the muscle supplied by these branches was generally resected with the lesion.

After freeing the superficial and deep branches (dividing proximal branches of the anterior tibial nerve if necessary), the deep peroneal nerve was traced distally onto the interosseous membrane where it joined the anterior tibial vessels. These neurovascular structures were dissected free of both the tumor and the interosseous membrane, tracing them distal to the lesion. The fibula was then osteotomized and lifted anterolaterally. Freeing the interosseous membrane on the medial side of the fibula facilitated this maneuver. By lifting the bone up and laterally it was generally possible to free the anterior tibial vessels from the interosseous membrane and salvage these structures. If the soft tissue mass extended into the interosseous region it was sometimes necessary to sacrifice the anterior vessels in order to free the tumor from the popliteal and posterior tibial vessels. Generally, the final stage of tumor resection was excision through the tibiofibular joint or alternatively by osteotomy through the lateral tibia.

During the course of this dissection it was often necessary to dissect the neurovascular structures from the reactive pseudocapsule at the periphery of the tumor, resulting in intralesional or marginal resection margins. As mentioned above, branches of the nerves that entered directly into tumor tissue were not salvaged.

During the final stages of resection the fibular collateral ligament was divided. After the resection had been completed the fibular ligament and the biceps tendon were brought down to the lateral tibia with the knee in about 20° of flexion. An osteoperiosteal hinge was elevated from the lateral tibia and the transferred ligament and tendon placed under this hinge of bone and held in place with a staple (see Fig. 3). Supplementary fixation was provided by nonabsorbable sutures placed in the adjacent iliotibial band fascia and periosteum. Stability of the repair was tested through a range of motion and a postoperative brace applied that permitted this safe range of motion. Prior to the reconstruction of this ligament/tendon complex, each knee opened widely when varus stress was applied.

Fig. 3. Postoperative radiograph demonstrating fixation of the lateral ligament to the lateral tibia using a bone staple.

RESULTS

There have been no cases of tumor recurrence in any of these five patients followed at our center for at least 2 years. There were no major postoperative complications. All patients came out of their braces by 8 weeks after surgery and all had full extension and more than 100° of flexion by 4 months after surgery. At present all are fully weight bearing without walking aids and no patient restricts ambulation because of the knee. No patient reported any joint instability and all have returned to full recreational activities. However, no patients were involved prior to or after treatment in high demand sports that required lateral cutting. Every patient achieved an excellent rating on MSTS scoring by 1 year and at final follow-up.

On examination three of the five knees demonstrated grade 1 laxity in varus stressing, especially in 20° of flexion. One knee was undistinguishable from the contralateral normal side in both flexion and extension testing. One knee was normal in extension but had slight opening in flexion on varus testing. All examinations demonstrated a firm end point and were pain free.

No patient requires an ankle foot orthosis. Four patients had normal peroneal nerve function. One patient demonstrated mild weakness of both extensor hallucis longus and tibialis anterior on motor testing. This weakness was not troublesome to the patient and did not require the use of an ankle foot orthosis.

DISCUSSION

Most cases of GCT of bone can be adequately managed by curettage, following by filling of the cavity using either bone graft or methylmethacrylate cement [6,12]. This method has proven effective in preventing local relapse of this benign locally recurrent tumor in 80–90% of patients 2–5 years after surgery.

Despite the excellent results obtained by this technique, some anatomical sites are better suited to complete excision of the tumor. Locations that are better treated by resection rather than curettage include the wing of the ilium or ischium of the pelvis (as long as the periacetabular region is not involved), the clavicle, body of the scapula, the distal radius, as well as the proximal fibula [3,8,9]. In these locations, curettage has been associated with an

unacceptably high risk of local recurrence [8], or the site may be removed without major disability. Indeed the fibula is often considered a "dispensable" bone that may be harvested with minimal functional loss for purposes of vascularized bone transplantation.

The proximal fibula, although not essential to limb stability, is recognized as a complex surgical site because of the proximity of the peroneal nerve. It is well recognized that operations in this region may be complicated by peroneal nerve palsy [10] and it is remarkable that the five patients reported above did not suffer from major postoperative paresis. It is certainly possible that a slow process of nerve traction resulting from the gradual expansion of the soft tissue mass at the neck of the fibula may have protected the nerve from operative dissection. However, Gitelis et al. [12] noted that two of three patients treated for proximal fibular tumors developed peroneal palsy postoperatively. Certainly it is necessary to free the nerve completely from the fibro-osseous tunnel at the fibular neck as well as the tunnel formed by the fascia between the lateral and anterior compartments. Once these sites have been freed, considerable displacement of the nerve can be achieved with minimal tension.

We found in all cases that the tumor had expanded anteriorly into the extensor digitorum longus at its point of origin from the fibula. Generally, this soft tissue extension was excised en bloc with the tumor and branches leading into this muscle often sacrificed. Indeed, the two most proximal branches of the nerve were often sacrificed to permit retraction of the nerve and this likely accounts for the mild weakness in the extensor musculature encountered in one of these five patients. Fortunately the motor supply to these extensor muscles is often provided by more than one branch [10].

Reconstruction of the lateral collateral ligament and biceps tendon to the lateral aspect of the tibia is a straightforward, reliable technique. When choosing the point of attachment of the tendons to bone we put the knee through a flexion-extension range attempting to locate the most "isometric" point for ligamentous reconstruction. The lack of symptomatic instability in the patients treated with this technique suggests that the method has merit.

There has been relatively little written about the management of GCT of the proximal fibula [7,12]. Most reports have suggested that the lesion should be resected but have not emphasized that the peroneal nerve can be preserved nor that the lateral stabilizers of the knee can be restored with excellent functional results. Although GCT of the proximal fibula is a rare tumor, attention to the biopsy, resection, and reconstruction of the lesion can result in a satisfying clinical outcome.

CONCLUSIONS

Five patients with GCT of the proximal fibula were managed by preservation of the peroneal nerve, en bloc excision of the tumor followed by reconstruction of the fibular collateral ligament. At minimum 2-year follow-up there have been no local relapses. One patient has minor peroneal nerve motor weakness, and none have clinically troublesome knee instability.

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COMMENTARY

This is an excellent technical paper on the en bloc resection of the proximal fibula for a GCT, using deliberate dissection of the common peroneal nerve and its branches, as well as the distal popliteal, anterior, and posterior tibial vessels and the tibial nerve. The undersigned has also found these general principles and approach of exposure outlined in this article useful in the resection of sarcomas of this area [1,2].

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